

METHOD OF INTERCONNECTING COMPUTERS AND COMPUTER NETWORK

Background of the Invention

Technical Field

5 The present invention generally relates to the art of  
connecting computers and specifically to a method of  
interconnecting at least two server computers, generally  
pertaining to differing corporate entities; each server  
10 being connected with a least one client computer and  
including, or having access to, a workflow control  
application.

Prior Art

15 Workflow control means and applications are well known in  
the art and operate with different media. Typical  
electronic workflow control applications (also termed  
Workflow Management System or WfMSs) are available  
20 commercially in various types and from various sources,  
e.g. in the form of specialized systems, such as "MQ  
Series Workflow®" from IBM or "TeamFlow®" from ICL, or as  
parts of so-called Enterprise Resource Planning Systems,  
such as R3® by SAP and Baan® by the Baan Company.

25 Today's systems of this type do not distinguish between  
and external view of a process that is visible outside  
the organization and its internal details. Their  
interfaces are generally aimed at the internal user.  
30 This is a problem if one organization (provider  
corporation) wants to perform a process on behalf of  
another (requestor corporation) so that it can be

initiated and accessed by the requestor corporation through an automated interface and, vice versa, so that results generated by the provider can be reported back to the requestor.

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This issue gains importance; specifically, an increasing need to outsource non-core business leads to increased service activity between separate companies. However, business organizations do not normally want to make internal information available to business partners nor do they wish to restrict their ability to conduct business internally. If separate organizations enter into a business relation, they will normally conclude an agreement or contract defining the circumstances under which the requestor corporation might initiate a process in the provider corporation and exchange further information when performing the process. As used herein, the term "contract" is a description of mutual obligations in the form of a protocol.

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The use of server computers running a workflow control application in one and the same organization has been an issue for some time. Organizations want to deploy more than one server to balance workloads or to provide service at different sites that are connected by low bandwidth or only intermittently. If several servers are used, process templates have to be distributed as well as states and data of processes and activities. The various distributed parts have to be kept consistent. This problem has been discussed and described in the art; some solutions have been implemented in commercial products, such as IBM's MQ Series Workflow® mentioned above.

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For the purpose of this specification, the terms "server" and "server computer" are used synonymously and refer to an electronic computer which functions as a "host" computer and is capable of being operatively connected with one or more "clients" (short for "client computer"). The connection of a server and at least one client results in a "net" (short for interconnected electronic computers).

A related issue is interoperability between workflow control applications of different vendors. Grown computer infrastructures tend to be heterogenous. This is a problem of providing standard interfaces to workflow control applications for server-to-server communication. Various attempts have been made at defining such an interface, e.g. by the 'Workflow Management Coalition', (a consortium of workflow control application vendors and users) which has created an interface called Interface 4 (cf. Technical Report WfMC-TC-1013, edited by the Workflow Management Coalition (1995), Hampshire, England). The term "interface" is used to refer to a physical or virtual means capable of causing operative interconnection connection of physical and/or virtual entities.

These known interfaces help to cross vendor boundaries but do not cross corporate limits. Notably, such issues as privacy, flexibility and independence are not addressed because the relationship between internal (i.e. inter-corporate) and external (i.e. intra-corporate) interfaces is not a subject of such interfaces.

Another prior art attempt, i.e. the 'Wide Area Groupflow' system (cf. Nastanski et al; "Managing business process in virtual enterprises- interaction of distributed workflow mangament systems"; *Proceedings of the ESTIEM, IT-Vision Conference, Paderborn (1997)*; and Riempp, G., et al, "Workflow management between distributed organizations-the wide area groupflow approach", in Lehner et. Al(ed.) *Proceedings of the ESTIEM, IT-Vision Conference; Deutscher Universitätsverlag, Wiesbaden 1997*) suggests to connect processes across organizational boundaries. While this approach addresses the issue of privacy, it requires that the organizations declare process templates as externally accessible. As a consequence, this approach does not provide a means to map an external representation of a process to an internal one, which implies a loss of independence and flexibility.

Agreements and contracts are known per se in various fields of transactions, workflow management, and distributed systems in general: A first prior art contract approach (cf. Wächter, H. Et al; "The ConTract Model", in Elmagarmid, A.K. (ed.) *Database Transaction Models for Advanced Applications*, San Mateo 1991) enables a performance of long-lived transactions of the type that can be perceived as processes, by committing, at an early stage, those parts of a transaction for which compensation mechanisms have been agreed upon.

Another prior art system termed "Coyote Approach" provides similar mechanisms while explicitly taking into account that services as parts of transactions can be

executed in different organizations (cf. Dan, A. et al,  
"The Coyote Approach for Network-centric Service  
Applications; *Proceedings of the Workshop on High  
Performance Transaction Processing HPTP, Asilomar 1997*).

5 The external services contemplated in this approach are  
short-lived, however. Similar properties are provided by  
the more recent TOWEC Approach (Verharen, E.M. et al,  
"Introducing contracting in distributing transactional  
workflow" in *Proceedings of the 31st Annual Hawai  
10 International Conference on System Science, New York  
1998*); it allows closing contracts for process-type  
transaction steps rated 'very important'.

#### Summary of the invention

15 Now, the present invention is concerned with combining a  
contract approach with what is called a virtual  
enterprise co-ordinator (also termed VEC for short  
herein) explained in more detail below and developed to  
20 enrich such agreements by expressions for failure-  
responsibility of a process and to supervise these  
enriched agreements in the connector application having  
the function of a gateway. However, none of these  
approaches addresses terminology issues.

25 Accordingly, the present invention is directed to an  
improved method for interconnecting at least two server  
computers of different corporations, each of which is  
connected with at least one client computer, and wherein  
30 each server runs a workflow control application which  
may, but need not, be the same, and to solve the

terminology problem to guard privacy and independence of operation.

The present invention is further directed to a computer network comprising at least two server computers each of which is connected with a least one client computer, and wherein each server computer is running a workflow control application.

#### Brief Description of the Drawings

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

- Fig.1 shows a simple schematic view of interconnected server computers running workflow management system applications; and
- Fig.2 shows a schematic view of parameter mapping of work tasks.

#### Detailed Description of the Preferred Embodiment of the Invention

Now, according to a first embodiment the invention provides a method of interconnecting a first server computer of a service requestor and a second server computer of a service provider, each of said first server computer and said second server computer being connected to at least one client computer said first server

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computer running a first workflow management system application, and said second server computer running a second workflow management system application, said method comprising providing a first and a second connector application for permitting said first server computer access to a copy of said first connector application and for permitting said second server computer access to a copy of said second connector application, wherein said copies of said first and said second connector application each comprises a connection agreement for a first work task of a first workflow instance encompassed by said first workflow management system application which copy of said first connector application further comprises a first mapping table including a first service terminology and a common terminology, and which copy of said second connector application further comprises a second mapping table including a second service terminology and said common terminology, said first work task being transposed by said first mapping table from said first service terminology into an input data set in said common terminology, said input data set being marshalled to said second server computer over a common connection, and said marshalled input data set being transposed to a second work task by said second mapping table from said common terminology into said second service terminology, and said second work task being processed by said workflow management system application.

According to a second embodiment, the invention provides a computer network comprising a first server computer of a service requestor and a second server computer of a

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service provider, each of said first server computer and  
said second server computer being connected to at least  
one client computer, said first server computer running a  
first workflow management system application, and said  
5 second server computer running a second workflow  
management system application, said first and second  
server computer being interconnected by means of a first  
and a second connector application arranged in such a  
manner that said first server computer having access to a  
10 copy of said first connector application and said second  
server computer having access to a copy of said second  
connector application, wherein said first and said second  
connector application each comprises a connection  
agreement for a first work task of a first workflow  
15 instance encompassed by said first workflow management  
system application, which copy of said first connector  
application further comprises a first mapping table  
including a first service terminology and a common  
terminology, and which copy of said second connector  
20 application further comprises a second mapping table  
including a second service terminology and said common  
terminology said first work task being transposed by said  
first mapping table from said first service terminology  
into an input data set in said common terminology, said  
25 input data set being marshalled to said second server  
computer over a common connection, and said marshalled  
input data set being transposed to a second work task by  
said second mapping table from said common terminology  
into said second service terminology, and said second  
30 work task being processed by said second workflow  
management system application.



According to a preferred embodiment, the results of the second work task of the second workflow management system application are transposed by the second mapping table from the second service terminology into an output data set in the common terminology, wherein the mapped output data set is marshalled to the first server computer over the common connection, and the marshalled output data are transposed by the first mapping table from said common terminology into said first service terminology.

According to another preferred embodiment, the first and second connector applications reside in a first and second access device of the service requestor and the service provider, wherein each access device comprises an access computer including the connector applications.

In a further preferred embodiment of the invention, the connector applications reside in the server computers of the service requestor and the service provider.

According to another preferred embodiment the connector applications reside in the client computers, which are connected to the service requestor server computer and to the service provider server computer.

The following description references Fig.1. The service requestor organization 1 has service requestor server computer 112 with a workflow management system application (WfMS) 3 and one variant of an Access Device: 5 the Service Requestor's Access Device. The service provider 2 has service provider server computer 122 with

a WfMS 4 and the other variant of an Access Device: 6 the Service Provider's Access Device.

Before a work task of a service requestor 1 can be outsourced to a service provider, several operations must be completed:

- an accord between a service requestor and a service provider must be established either verbally in written form or by some other means,
- a workflow template must be established in the service requestor's WfMS 3 with one of the workflow's sub-tasks representing a work task 7 to be outsourced,
- a workflow template 15 must be established in the service provider's WfMS 4 to represent the processing of the whole outsourced work task 15,
- a connection agreement must be created and a copy is stored in the service requestor's Access Device 8 and the service provider's Access Device 12,
- mapping tables 9 and 13 describing how to map data items described in the workflow templates to data items described in the connection agreement are created and stored in the service requestor's Access Device 9 and the service provider's Access Device 13.

Once the above criteria have been established, the system is capable of outsourcing tasks. The following text is an overview of successfully processing a single outsourcing task using a previously established connection agreement 8 and 12 as described above. The

device allows many instances of such a process using the same or different connection agreements to run concurrently.

5 A workflow instance 18 of a workflow template is created. Using a workflow interface 11 provided by the WfMS 3 the service requestor's Access Device 5 detects when the workflow reaches a point where it is appropriate to request the service provider to perform the outsourced  
10 work task 7. The correct connection agreement 8 is located, this indicates the details of the service provider 2 and the relevant data mapping table 9. According to this, information data is retrieved from the workflow instance 18 and marshalled into a format that  
15 can be interpreted by the service provider's Access Device; this is termed the input data ip1, ip2 (see also Fig.2). The request to start the outsourced task together with said input ip1, ip2 is passed across a  
20 computer network 17 to the service provider's Access Device 6. On receiving the request the service provider's Access Device locates it's copy of the connection agreement 12; this indicates the mapping table 13 to use to marshal the input data and the name of a workflow  
25 template 15 for the outsourced task. The service provider's Access Device marshals the input data into the form defined in the workflow template using the mapping table 13. The service provider's Access Device then starts a new workflow instance 19 of the workflow  
30 template 15 using the WfMS workflow client computer interface 16. A connection record 14 is created and stored in persistent memory.

The service provider's Access Device 6 detects the completion of the workflow instance 19 using the workflow client computer interface 16 to the WfMS 4; the completion code and any output data of the workflow instance is retrieved. The connection record 14 is used to retrieve the mapping table 13 that is in turn used to marshal the data into the format that can be interpreted by the service requestor's Access Device 5, this is said to be the output data op1, op2. Said output data op1, op2 is then sent to the service requestor's Access Device across the computer network 17. The connection record 14 is removed from the system. On receiving the notification from the service provider's Access Device the service requestor's Access Device 5 retrieves the respective connection record 10. The connection record allows the correct mapping table 9 to be retrieved and used to translate the output data into the format define by the workflow template 7. The completion of the outsourced task is signalled and said translated data is passed to the WfMS 3 using the workflow client computer interface 11.

The mapping tables 9 and 13 for the purposes of this invention are described in more detail with reference to Fig. 2:

The mapping table 9 of the service requestor maps the work task 7 from a first service terminology 9a into common terminology 9b. The result of this mapping are the input data ip1 and ip2, which are marshalled over the connection 17 to the mapping table 13 of the service provider. The mapping table 13 of the service provider

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maps the input data ip1, ip2 from the common terminology 13b to the second service terminology 13a for the work task 15 of the service provider. The result of the work task 15 of the service provider is mapped by the mapping table 13 of the service provider from the second service terminology 13a to common terminology 13b. This mapped result comprises the output data op1, op2 which are marshalled to the mapping table 9 of the service requestor. This mapping table 9 maps the output data op1, op2 from common terminology 9b to the first service terminology 9a, which output data serve as a result of the outsourced work task 7.

The inventions as described above allows the service requestor and the service provider to save privacy, flexibility and independence as follows:

Privacy: All communication from a process of sub-process to the outside or vice versa is sent through and controlled by the connection applications. No direct interaction between workflow control application of different organizations takes place. No information will be exchanged beyond what has been specifically defined in the agreement according to which the process and sub-process are connected.

Flexibility: By mapping the common view of a sub-process onto the respective internal representations, both organizations are free to modify on both individual and template level. However, an internal modification might entail the requirement for an organization to also change its mapping.

